COMMERCIAL MAINTENANCE AND OPERATION MANUAL

For the Orion Model 301 Analog pH Meter

DEPMEDS AT-05 AND AT-06

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CONTENTS

Introduction	3
Instrument Description	3
Front Panel	3
Rear Panel	3
Unpacking, Assembly Set-Up and Checkout	4
Unpacking	4
Check Out	4
Measurement Procedures	5
General	5
PH Measurements	5
Potentiometric Measure	6
Functional descipt of equip	6
Service Information	7
Test Voltage	7
Troubleshooting Guide	7
Instrument Warranty	8
Repair and Service	8
Ordering Information	9
Specifications	9
Prevent Maint & Storage	10
Semiconductors & Fuses	10
Parts List	11
Schematic	12
Blow Up Illustration	13
PC Board Layout	14

ILLUSTRATIONS

Fig #	Page	Descr
1	3	Front Panel
2	3	Support Rod Attachment
3	6	Functional descript of equip
4	12	Schematic
5	13	Blow Up
6	14	PC Board Layout

INTRODUCTION

The model 301 is a line operated (100-240 VAC) analog pH meter designed for routine pH measurements. It measures the hydrogen ion concentration (pH) of a solution via the use of a pH electorde and a readout meter. The electrode is inserted in the test solution and a current is applied to it from the meter. An electrical circuit is completed through the electrode and test solution and is measured by the meter, giving a readout of hydrogen ion concentration. (pH).

A mirrored scale allows pH to be read to +/- 0.05 pH units over the entire range of pH from 0-14. A +/- 400 mv scale is useful for ORP (redox) measurements or potentiometric titrations.

INSTRUMENT DESCRIPTION

Front Panel

Meter Scales

Upper scale, numbered from 0-14 in units of 0.2 pH. Lower scale, numbered from -400 to +400 in units of 20 mV.

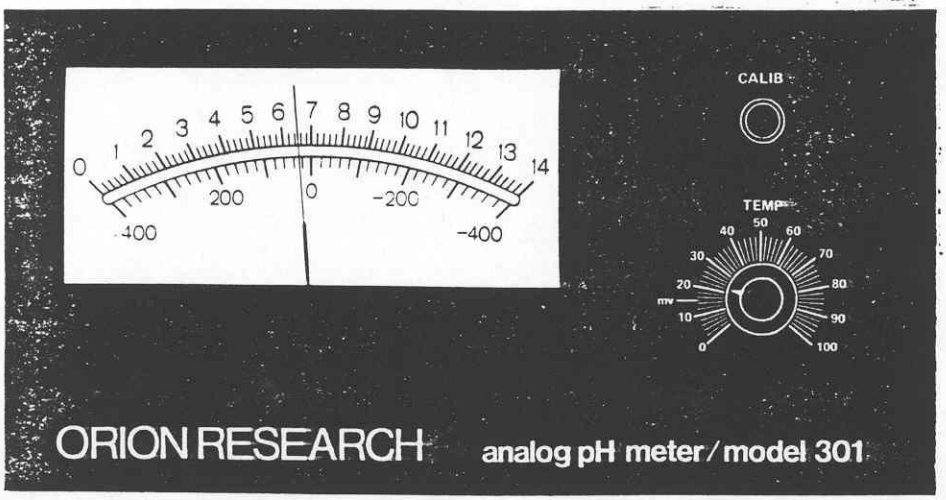
Controls

CALIB Used to calibrate the instruments on buffers of known pH.

TEMP Adjusts electrode slope when calibrating or changing temperature. Scale is marked from 0 to 100 deg C in 2deg C increments.

zero adjust screw Screw located on the front panel directly below center scale. Used to set needle to center scale when the meter is not connected to line power.

Figure 1 Front Panel



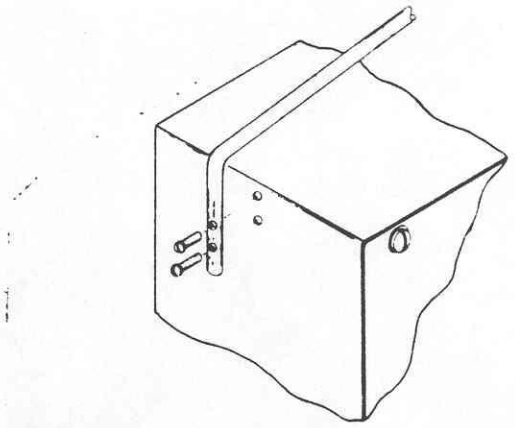


Figure 2
Attaching Support Rod

Rear Panel

Reference Electrode Jack

(red) Accepts standard pin-tip connectors on reference electrodes or combination electrodes. The connector should be firmly seated in the jack. To release, pull connector straight out of the jack.

Sensing Electrode Jack

(black) Accepts pH, specific ion, and redox electrodes with US standard connectors. To insert electrode, push down on the outer black ring of the jack.

Unpacking

1) Open the box and remove all packing materials from the unit and accessories. Be sure that all of the following components are included; Model 301 meter, Model 910500 combination pH electrode, support rod, electrode holder, shorting strap and 1 pack each of pH 4,7 & 9 buffers.
2) Turn the instrument on its side and attach the electrode support rod. Align the two holes on the support rod with the 2 holes on the case and fasten with the supplied screws (see figure 2).
3) Mount the electrode holder on the support rod, hold in position and tighten the thumb screw.
4) Plug the combination pH electrode into the jacks at the back of the unit and mount the electrode on the electrode holder.
5) Locate the unit in a dry temperature stable environment in the 10 to 40 deg C range.
6) If using a 110-120 volt AC power supply, plug the unit directly into the power source. If using a 210-240 V AC power source, plug the unit into the supplied transformer and in turn plug the transformer into the power source.
7) The meter is now ready to be used. No further equipment other than what is provided with the unit is needed to measure pH.

If not already available, buffer solutions will have to be prepared using distilled water and the buffer packets enclosed. Please follow instructions on the buffer packets for buffer solution preparation.

CHECK-OUT

1) Disconnect the meter from a power source and check the position of the meter needle. If the needle does not point exactly to center scale, adjust its position with the zero adjust screw.
2) Connect the meter to the power source.
3) Insert the shorting strap in the sensing and reference jacks on the rear panel. Allow 30 minutes for the unit to reach temperature equilibrium.
4) Set the temp control to "mv" (15C).
5) Turn the CALIB control in both directions and check that the needle can be brought from 0 to 14 on the pH scale.
6) Set the needle to pH 7 (center scale). Check that the reading is stable.
7) Turn the TEMP control fully counterclockwise. Turn the CALIB control to set the needle to 0 on the pH scale (full-scale left).
8) Turn the TEMP control fully clockwise. Check that the needle points to 2.00 + or - 0.05 ph units.

MEASUREMENT PROCEDURES

General

1) All samples and buffers should be at the same temperature as electrode slope, reference electrode potential, buffer pH, and sample pH are temperature dependent. The sample temperature should be recorded along with the pH value.
2) Prepare and store electrode(s) as indicated in electrode instruction manual.
3) Stir both buffer and sample solutions with a magnetic stirrer. Place a piece of insulating material between stirrer and beaker to prevent transfer of heat to sample.
4) Rinse electrode(s) with distilled water between measurements.

pH Measurements

Single-Buffer Standardization (where maximum precision is not required)
1) Place the electrode(s) in a buffer solution whose pH is within +/-1.5 pH units of the expected pH of the sample.
2) Set the TEMP control to the temperature of the buffer.
3) Allow the buffer reading to stabilize, then adjust the CALIB control until the meter needle points to the pH of the buffer
(see table on back of buffer package for proper value.)
4) Remove the electrode(s) from the buffer solution and rinse.
5) Place the electrode(s) in the sample. Allow the reading to stabilize and record the pH.

Two-Buffer Standardization

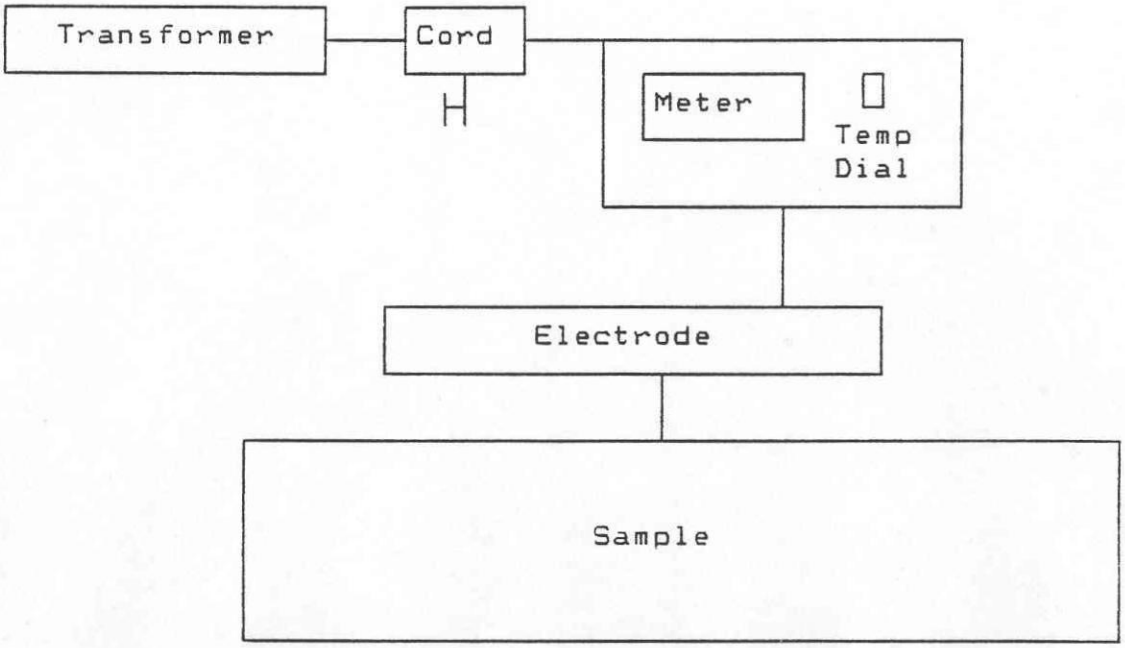
1) Select two buffers whose pH brackets the expected pH of the sample, the first should be a pH 7 buffer.
2) Place the electrode(s) in the pH 7 buffer, allow the reading to stabilize, and turn the CALIB control until the needle points to the pH of the buffer. (See table on back of buffer package for proper buffer value)
3) Remove the electrode(s) from the first buffer and rinse.
4) Place the electrode(s) in the second buffer and turn the TEMP control until the correct pH is displayed. If the TEMP control has to be changed by more than 10 deg C from the actual temperature, the electrode may require cleaning or replacement.
5) Remove the electrode(s) and rinse.
6) Place the electrode(s) in the sample. Allow the reading to stabilize and record the pH.

POTENTIOMETRIC MEASUREMENTS

The Model 301 can be used for potentiometric titrations, especially redox titrations, and other potentiometric measurements where the accuracy of +/-5mV is acceptable. When making potentiometric measurements:

1) Set the TEMP control to the "mV" mark (15 deg C).
2) Plug the connectors of the shorting strap into the sensing and reference jacks on the rear panel of the meter.
3) Turn the CALIB control until the needle points to "0" on the millivolt scale.
4) Remove the shorting strap and connect the electrode(s) to the meter.
5) Place the electrode(s) in the sample. If the needle comes to rest on scale, record the steady electronic reading. If the needle comes to rest off-scale, disconnect the electrode(s) and reconnect the shorting strap. Turn the CALIB control to bring the needle to full-scale at the OPPOSITE side of the off-scale deflection. This rescales the meter so that it reads from 0-800 mV, if the needle has been brought to full-scale right, or 0 to -800 mV if the needle has been brought to full-scale left. Reconnect the electrode(s) and record the reading, taking into account the rescaled values.

FUNCTIONAL DESCRIPTION OF EQUIPMENT Fig #3



The meter measures hydrogen ion concentration (pH) by submersion of the electrode in the sample. An electrical current is sent from the electrode to the meter, where it is measured and displayed as pH on the scale. The meter is powered by AC current derived from the connection of the cord to a 115 volt voltage source or connection of the cord to the transformer which is connected to a 220 volt supply line.

SERVICE INFORMATION

Test Voltage

The following test voltages were measured on a typical instrument with nominal line supply voltage. The voltages must be measured with a voltmeter having a sensitivity of at least 20,000 /volt.

Measuring Points	Voltage
Across capacitor C1	+10V DC nominal
Across capacitor C4	-10V DC nominal
Cathode to anode of CR5	6.2V DC stabilized
Across secondary of transformer T1	13V AC nominal at 115V AC input

Troubleshooting Guide

The following is a suggested list of the most likely problems and their possible causes. Circuit references refer to the appropriate components on the circuit diagram in Figure 3.

Problem	Possible Causes
Stabilized voltage zero or very low	R2 open circuit
Stabilized voltage high	CR5 short circuit
Meter pointer pegged up scale for control setting	RP1 wiper contact open circuit Z1 faulty Q2 very high leakage or faulty pin connection
Meter pointer pegged down scale	Q2 gate open circuit Z1 faulty
Meter pointer doesn't move at all	R10 open circuit Meter M1 open circuit
Meter gives erratic readings	Z1 suspect RP2 wiper contact suspect
Buffer adjustments erratic	RP1 faulty
Sensitivity incorrect (i.e. standardization check does not work)	Glass electrode faulty RT1 or RT2 suspect R8 suspect
Meter pointer drifts aimlessly with no response to pH changes	Electrode faulty Open-circuit input
Unstable reading when measuring grounded solutions	Check for low resistance (less than 1M)between reference line and earth ground. Check both electrodes insulation. Check transformer core connection to meter wrapper
Meter reading changes with ambient temperature	Q1 faulty CR5 faulty Feedback components (RT1, RT2, or R8) suspect
Meter reading disturbed by electrical circuits outside instrument	C2, C9 or Q2 suspect

INSTRUMENT WARRANTY

Orion Research Incorporated warrants that this instrument will operate for one year from the date of purchase when used under normal laboratory conditions, and in accordance with the operating limitations and maintenance procedures given in the instruction manual. In the event of a failure within the warranty period, Orion, or its Authorized Dealer, will, at Orion's option, repair or replace the non-conforming instrument at no charge to the customer.

THE WARRANTY DESCRIBED ABOVE IS EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTY, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, EXCEPT TITLE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR, OR REPLACEMENT OF THE DEFECTIVE INSTRUMENT OR PART, OR REFUND OF THE PURCHASE PRICE; BUT IN NO EVENT SHALL ORION (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OR ANY PERSON, IN CONTRACT OR IN TORT (INCLUDING NEGLIGENCE) FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Representations and warranties made by any person, including dealers, representatives and employees of Orion, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Orion unless in writing and signed by one of its officers.

"NO LEMON" Instrument Warranty

The instrument is covered by the Orion "No Lemon" Warranty. If it fails within twelve months from date of purchase for any reason other than abuse, the purchaser may elect to have it repaired or replaced ay no charge. This warranty covers the original or replacement/repaired meter from date of original meter purchase; the warranty is not extended beyond the buyer's original warranty date.

REPAIR AND SERVICE

A Return Authorization Number must be obtained from Orion Laboratory Products Customer Service before returning any product for in-warranty or out-of-warranty repair, replacement or credit.

Consult:

Orion Research Incorporated
The Schrafft Center
529 Main Street, Boston, MA 02129 USA
Telephone 617-242-3900/Telex 4430019

In Europe, the Middle East, and Africa contact your Authorized Orion Dealer, or:

Orion Research AG
Fahnlibrunnenstrasse 3
CH-8700 Kusnacht, Switzerland
Telephone 01-910 7858/Telex 57829

ORDERING INFORMATION

Cat No	Description
910004	pH 4 buffer packets, box of 25 packets, each packet making 200ml of buffer
910007	**pH 7 buffer packets, box of 25 packets, each packet making 200 ml of buffer.**
910009	pH 9 buffer packets, box of 25 packets, each packet making 200 ml of buffer.
910104	**pH 4.01 buffer, 475 ml bottle**
910107	pH 7.00 buffer, 475 ml bottle
910110	**pH 10.01 buffer, 475 ml bottle**
040030	Shorting strap

TABLE OF EQUIPMENT SPECIFICATIONS

Package contents: Model 301 analog pH meter, with model 910500 combination pH electrode, support rod, electrode holder shorting strap, transformer and one packet each of pH 4, pH 7, and pH 9 buffers

Ranges: 0-14 pH; + 400 mv to -400mv

Readability: + or - 0.05 pH units
+ or - 5mv

Temperature compensation: manual (0-100C)

Isopotential point: pH 7 (fixed)

Power consumption: 0.3 watts at 100 V; 50/60 Hz

Relative accuracy: + or -2% full scale deflection

Dimensions : 12cm high by 24 cm by 10 cm deep

Weight: 3.0 kg

PREVENTATIVE MAINTENANCE

1) The meter should be kept dry as much as possible, clean and dry it as it becomes necessary.
2) The electrode should be stored when not in use IAW the electrode instruction manual.
3) The unit should be calibrated per the pH measurement procedure on page 4 each time the meter is used. It should be checked using the checkout procedure on page 3 once a month.
4) The electrode should be replaced after every 50 hours of usage or more often if stable readings cannot be obtained. It should also be replaced if the bulb is allowed to dry out or if the meter cannot be standardized.
5) The only tool needed for adjustment/calibration is a small screwdriver.

STORAGE INFORMATION

1) The unit should be stored indoors in a dry environment. Temperature should fall within the range of 0-50 deg C. If being stored in a high humidity (74% RH) environment, the complete unit should be sealed in a weatherproof and moisture proof barrier package which includes a desiccant to absorb moisture. The unit will store indefinitely under these conditions. The unit should be inspected visually every 6 months to check for condensation on the inside of the moisture proof bag. If there is condensation, the desiccant should be replaced along with the moisture proof bag.
2) Do not stack anything on top of the units.

LIST OF SEMICONDUCTORS AND FUSES

Part #	Description
200302-001	Potentiometer
200301-001	Potentiometer
701117-A01	PC Board Assembly
200228-001	Diode, Silicon
200226-001	Diode, Zener
200225-001	Diode, Zener
200518-001	Transistor, FET
200292-001	Amplifier
200352-001	Trimpot

PARTS LIST

Part #	Description
800571-001	Front Panel
501045-001	Meter Movement Assembly
200302-001	Potentiometer (Temp)
200301-001	Potentiometer
200266-001	Knob, Skirted
200268-001	Knob, Plain
800650-A2	Assy Input Connector
900000-000	Bumper, Rubber-Front
900000-001	Bumper, Rubber-Rear
701087-001	Rear Panel
200532-001	Strain Relief Bushing
701117-A01	PC Bd. Assy
200228-001*	Diode, Silicon
200266-001*	Diode Zener (10VDC)
200225-001*	Diode Zener (6.2V)
200518-001*	Transistor FET
200292-001*	Amplifier Op Comp IC
200352-001*	Trimpot
800558-001	Transformer
910500	Electrode
CO	Cord
EO	Electrode Holder
EH50	Electrode Holder Support Rod
910004	pH 4 Buffer
910007	pH 7 Buffer
910009	pH 9 Buffer
SDT-4	Stepdown acc. transformer
SP	Shorting Plug
R1 through R15*	Resistors
Q1 through Q5*	Transistors
C1 through C4*	Capacitors

* = part of PC Board Assembly, these parts are not available separately.

FIGURE 3

MODEL 301 SCHEMATIC

LEGEND

C= CAPACITOR
R= RESISTOR
T= TRANSFORMER
M= METER
CO= CORD
P= PLUG
J= JACK
RP= POTENTIOMETER
RT= POTENTIOMETER
TP= TEST POINT
CR= DIODE

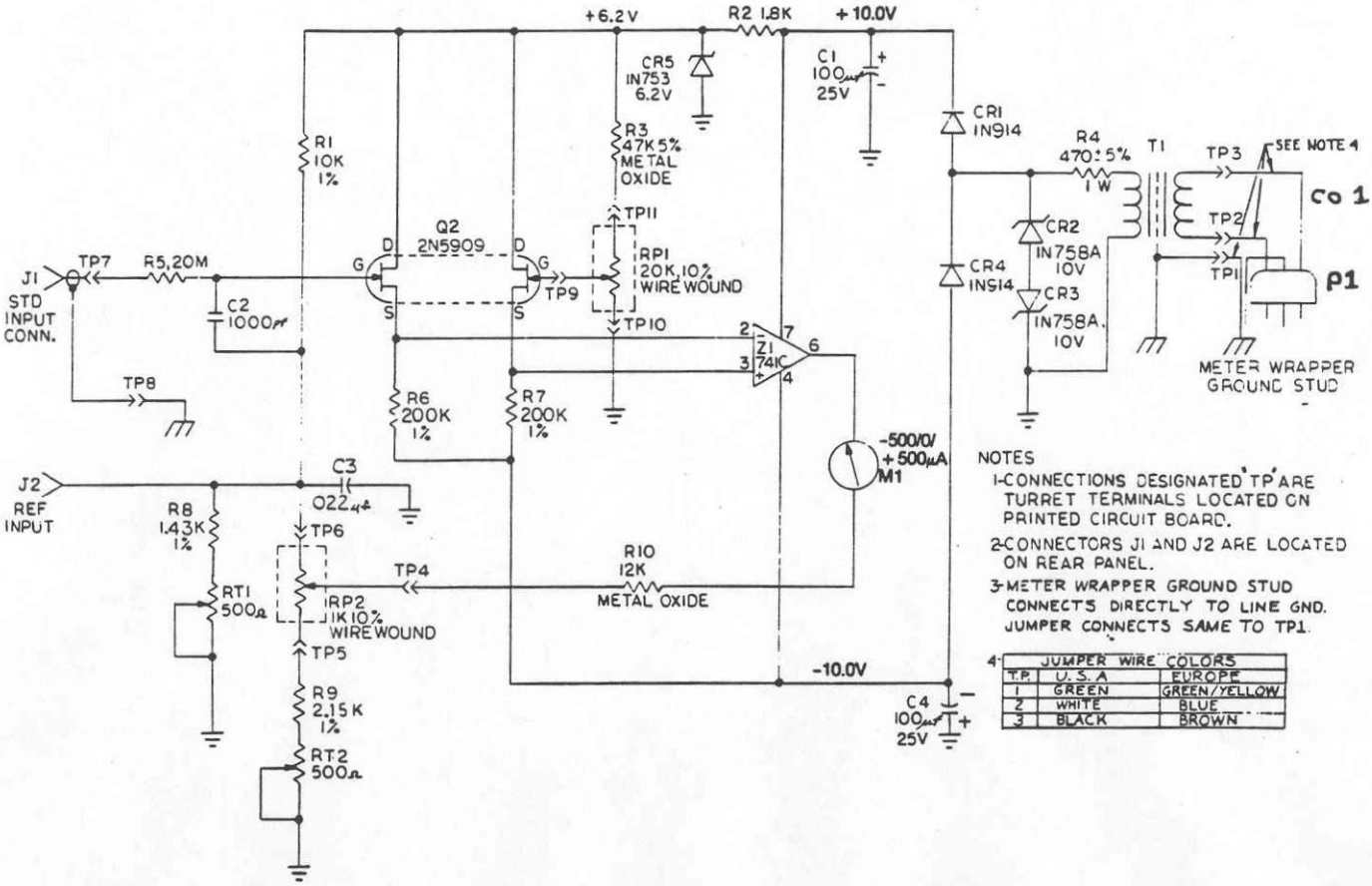
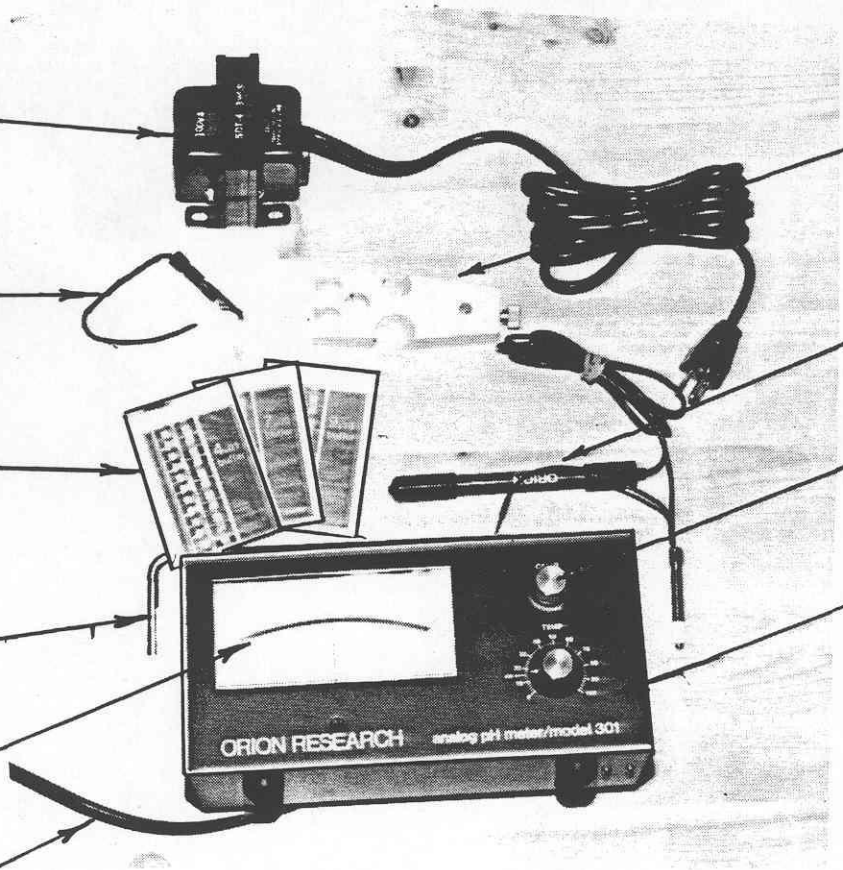


Figure 3
Model 301 Circuit Diagram

Figure 5 Blow Up



STEPDOWN ACCESS TRANSFORMER
#SDT-4

SHORTING PLUG
#SP

BUFFER PACKETS
#910004
#910007
#910009

ELECTRODE HOLDER SUPPORT ROD
#EHSO

METER MOVEMENT ASSEMBLY
#501045-001

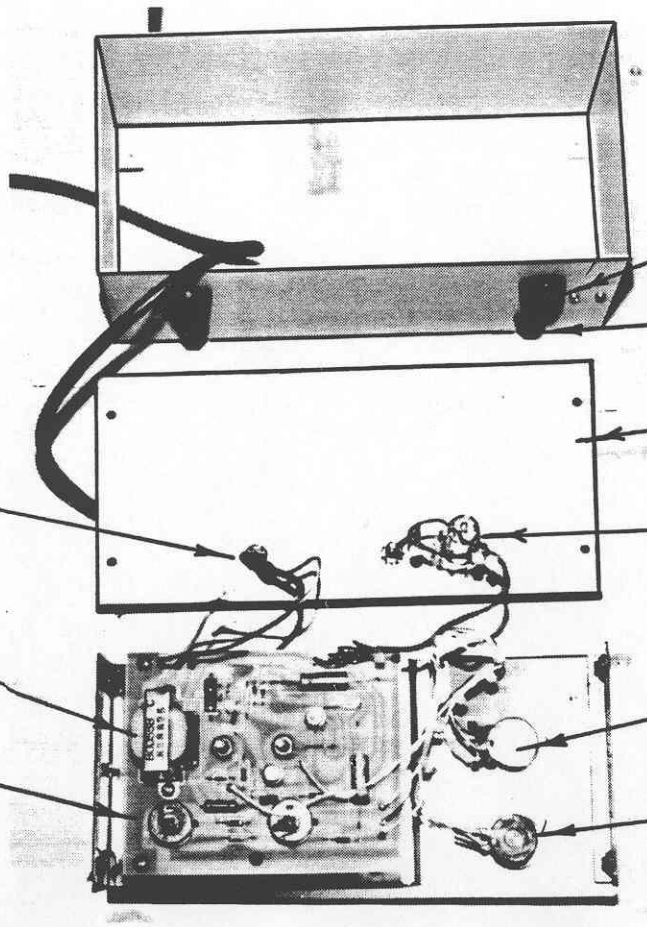
CORD #CO

ELECTRODE HOLDER
#EO

ELECTRODE
#910500

KNOB, PLAIN
#200266-001

FRONT PANEL
#800571-001



BUMPER, RUBBER, FRONT
#900000-000

BUMPER, RUBBER, REAR
#900000-001

REAR PANEL
#701087-001

STRAIN RELIEF BUSHING
#200532-001

ASSY INPUT CONNECTOR
#800650-A2

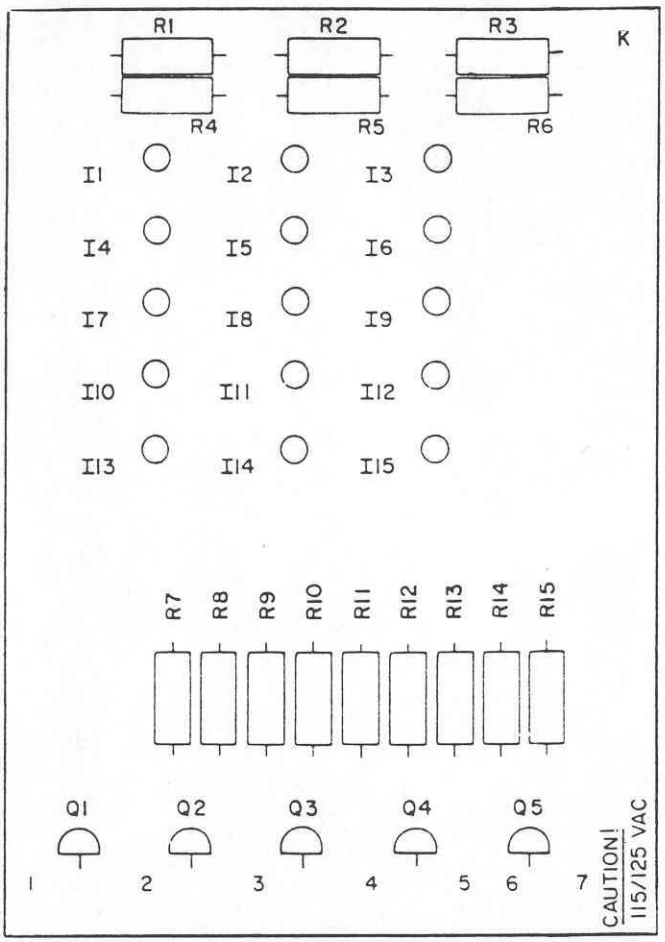
TRANSFORMER
#800558-001

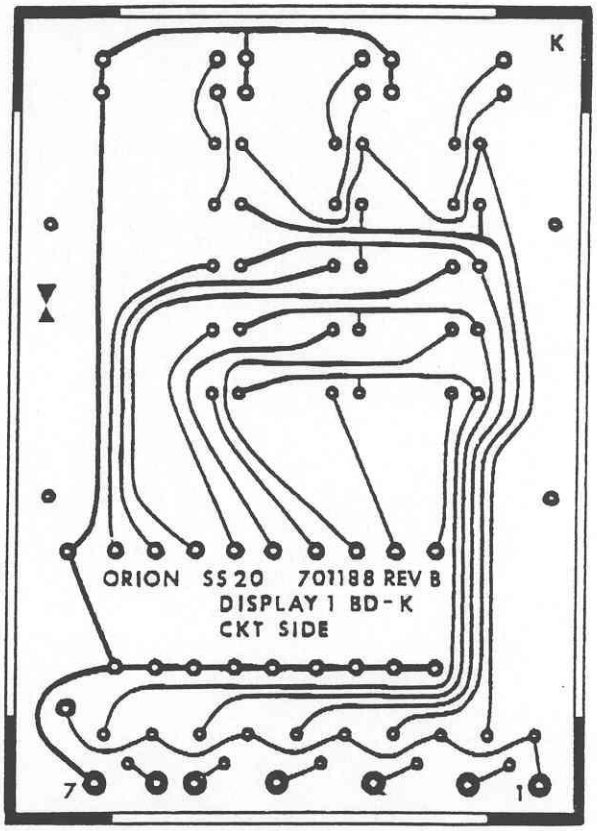
POTENTIOMETER(TEMP)
#200302-001

PC BOARD ASSEMBLY
#701117-A01

POTENTIOMETER
#200301-001

PC BOARD LAYOUT
FIG #6





LEGEND: R = RESISTOR, IE R1 = RESISTOR #1
Q = TRANSISTOR
I = CURRENT SOURCE CONNECTION